

## **REMARKS**

### **File History**

In the latest Office action of 4/7/2006, the following rejections, objections and other actions appear to have been made:

- Claims 1, 11, 14, 22 were rejected under 35 USC §102(e) as being fully anticipated by Kunori (US 2003/0100153 A1 published 5/29/2003 on application filed 8/7/2002).
- Claims 2-4, 10-13 were rejected under 35 USC §103 as being obvious over Kunori as combined with Lee (US 2005/0074982 A1 --a division of 6,844,604 filed 2/2/2001).
- Claims 5-6 were rejected under 35 USC §103(a) as being obvious over Kunori as combined with Lee and further in view of Yamazaki (US 2005/0040401 --a division of US 6,576,926).
- Claims 7-8 were rejected under 35 USC §103(a) as being obvious over Kunori as combined with Lee and Yamazaki and further in view of Yu (US 6,566,205 --issued 5/20/2003).
- Claim 9 was rejected under 35 USC §103(a) as being obvious over Kunori as combined with Lee and Yamazaki and further in view of Noguchi (US 2004/0094793 --based on 3/24/2003 US filing) .
- Claim 15 was rejected under 35 USC §103(a) as being obvious over Kunori .

### **Summary of Current Response**

Claims 1, 4, 7-9, 14, 22 are amended.

Claim 3 is canceled

Claims 23-34 are newly introduced.

Arguments are presented concerning the applied art and its proposed combination.

## Applicants' Overview of Outstanding Office Action

Claim 1 is amended to include limitations similar to those of original Claim 3. This moots the anticipation rejection based on Kunori. Applicant sees the remainder of the outstanding Office action of 4/7/2006 ("OA") as having the following noteworthy features:

(1) No motivation for combining Kunori with Lee is articulated and none can be reasonably provided because Lee is directed to the formation of a **metal silicate interface layer** (12) having a general formula of  $M_{1-x}Si_xO_2$  as set forth at Lee paragraph [0042]. The  $-O_2$  terminal portion of the  $M_{1-x}Si_xO_2$  formula is integrally provided during Lee's ALD process by means of a pulsed oxygen source such as  $H_2O$  or ozone as set forth at Lee paragraph [0050]. Nowhere does Lee teach or suggest to lay down an intrinsic silicon layer on a pre-nitrided surface by means of ALD. Layer 10 of Lee is silicon. Nowhere does Kunori teach or suggest to lay down an intrinsic silicon layer on a nitrided surface by means of ALD. A combination of Kunori with Lee, even if permissible, does not disclose the concept of laying down an intrinsic silicon layer on a nitrided surface by means of ALD.

(2) A critical fact finding error is made at page 4, paragraph 2, of the OA where the PTO finds that Lee paragraph [0046] teaches to deposit intrinsic silicon by means of ALD. Lee paragraph [0046] teaches no such thing. It is directed only to the **high-K metal silicate interface layer** (12) of Lee paragraphs [0040]-[0042].

## Nuanced Look at ALD Technology and Comments re Erroneous Motivation to Combine

At paragraph [0053] of the present specification, it is explained that ALD operates by the chemisorption of alternating monolayers of reactants and reaction between the reactants. The process needs to start with adhesion of a first of the monolayered reactants to the substrate. If the first monolayered reactant does not chemisorb to the substrate surface, the rest of the ALD process cannot proceed because each post-reaction monolayer serves as the base or template for chemisorbing the next round of reactants. So it is important to provide a base surface onto which the base monolayer of the ALD process will adhere. Adhesion may be interfered with if too much nitrogen is present at the base surface. The problem may be overcome by using a nitrogen gradient that has less concentration of nitrogen at its top. Paragraph [0051] of the specification states: "Various techniques can be used to form an oxidation-stopping gradient wherein nitrogen concentration in region 335 rises to ... to form a homogenous or graded Si<sub>x</sub>N<sub>y</sub> composition in region 335 to the Z7 depth .... to provide a nitrogen concentration gradient where nitrogen density increases moving deeper down the Z7 depth." [*Emphasis added.*] Paragraph [0052] of the specification explains in more detail as follows:

While Fig. 3B shows the surface layer 335 as having just a Si<sub>x</sub>N<sub>y</sub> composition, it is within the contemplation of the disclosure to incorporate other atoms within this region including an oxygen gradient whose oxygen density decreases moving deeper down the Z7 depth while at the same time nitrogen concentration increases when moving deeper down the Z7 depth. The oxygen atoms may be ion implanted or otherwise introduced into surface region 335 together with nitrogen atoms. The top of surface region 335 may be treated to enhance surface chemisorption in a subsequent ALD step 303 (Fig. 3C). [Emphasis added.]

Those skilled in the art will understand from the above that chemisorbing the first ALD reactant layer to the top of the  $\text{Si}_x\text{N}_y$  layer 335 (Fig. 3B) is not an inherent given. If the nitrogen concentration is too high at the top surface, it may interfere with the initial chemisorption of the base ALD monolayer because the nitrogen may reduce the number of dangling silicon bonds present at the surface. The example given at specification paragraph [0053] uses "A first of the pulse-supplied reactants (e.g., dichlorosilane  $\text{SiH}_2\text{Cl}_2$ ) [to] adheres— to the substrate surface as a chemisorbed monolayer." [*Emphasis and additional text added.*] The specification teaches to grade the nitrogen concentration so that a maximum nitrogen concentration is not found at the very top of the  $\text{Si}_x\text{N}_y$  layer 335 and the dichlorosilane will accordingly have more dangling silicon bonds to chemisorb to for better adhesion. On the other hand, a higher nitrogen concentration is desired for stopping or retarding the oxidation front when the intrinsic silicon is next thermally oxidized. Such heightened concentration of nitrogen is realized in one or both of two ways. First, as already noted above, the nitrogen concentration can be graded to be higher as one moves deeper down the Z7 depth of Fig. 3B. Alternatively or additionally, as is seen in Fig. 3F, oxidation may be driven into the nitride stop zone so as to consume silicon atoms for forming  $\text{Si}_w\text{O}_v$  (layer 344) and thus increasing the relative concentration of nitrogen in remaining region 335". This is explained at specification paragraph [0056].

Neither of Kunori nor Lee teaches or suggests these concepts. Kunori paragraph [0064] directs the ordinary artisan to use a single CVD process ("a CVD method") for successively forming the silicon oxide layer 2, silicon nitride layer 3 and doped or undoped silicon film 30. This implies a continuous use of silane (or of another single, silicon providing reactant) and a smooth transition in the same reaction chamber from adding oxygen for forming  $\text{SiO}$  to adding nitrogen for forming  $\text{SiN}$  to adding dopant for forming the doped version of silicon layer 30. Breaking the continuous or seamless process flow goes against the teachings of Kunori.

A somewhat related point arises from the assertion made at the bottom of page 6 of the Office action where the PTO proposes that mere rearranging of parts of an invention involves only routine skill, citing the 1950 case of *In re Japikse* (86 USPQ 70; CCPA). *In re Japikse* involved a mechanical device, namely, a hydraulic power press; and in particular the relocating of a starting switch (86 USPQ at 73). Since 1950, the courts have resoundingly

rejected the notion of per se rules and have recognized that every art area may have its own nuanced aspects regarding how an ordinary artisan thinks. With regard to semiconductor fabrication techniques (which have little to do with the design of a hydraulic power press), it is understood by artisans that it is economically advantageous to perform multiple steps in a single chamber without removing the wafer and thereby exposing it to contaminants.

Thus, since Kunori paragraph [0064] directs the ordinary artisan to use a single CVD process ("a CVD method") for successively forming the silicon oxide layer 2 and the silicon nitride layer 3, it would be unwise and against routine practice to not also form the doped or undoped silicon film 30 in that same chamber and by seamless continuation of the same general CVD deposition process. What the Office action is proposing by its assertion that the method of Lee should be employed for the intrinsic silicon film 30 of Kunori is that the ordinary artisan break completely away from the conventional approach, and that the ordinary artisan ignore completely the teachings of Kunori; and furthermore that the ordinary artisan ignore completely the teachings of Lee because Lee teaches to form a metal silicate with ALD, not an intrinsic silicon layer.

The Office action is under the erroneous impression that Lee paragraph [0046] teaches to use ALD for forming an intrinsic silicon layer. Careful review of Lee paragraph [0046] will show that this is not at all correct.

Essentially all outstanding grounds of rejection (save for the §102 grounds against Claims 1, 11, 14, 22 and the §103 grounds against Claim 15) rely on combining Lee with Kunori and rely on the erroneous belief that Lee paragraph [0046] teaches to use ALD for forming an intrinsic silicon layer. It is respectfully believed that all of these grounds have been overcome by the above discussion.

With regard to Claim 11, it depends from Claim 10. Use of a §102 rejection against Claim 11 and a §103 rejection against broader Claim 10 makes no logical sense and appears to be an inadvertent error. Moreover, the blanket assertion that Figs. 1-3 of Kunori teach the subject matter of Claim 11 is not supported by any facts.

With regard to Claim 14, the outstanding grounds of rejection appear to suffer from a double counting of the same layer 3 of Kunori. Claim 14 is amended to clarify that the silicon nitride layer is separate from the oxidation stop layer.

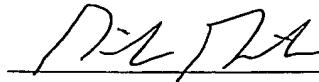
With regard to Yamazaki '401, this reference is directed to TFT structures. Layer 602a of paragraph [0125] is a SiON layer. 602b of paragraph [0126] is the SiN layer. An amorphous silicon film is formed above the latter SiN layer 602b. The amorphous silicon film is converted to a crystalline form as set forth in paragraph [0128] and thereafter patterned per paragraph [0129]. Applicant does not see where Yamazaki '401 teaches to use layer 602a or 602b as an oxidation stop.

### CONCLUSION

In light of the foregoing, Applicant respectfully submits that the rejections have been overcome and the application is in condition for allowance. Should any other action be contemplated by the Examiner, it is respectfully requested that he contacts the undersigned at (408) 392-9250 to discuss the application.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 50-2257 for any matter in connection with this response, including any fee for extension of time and/or fee for additional claims, which may be required.

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on June 23, 2006.



6/22/06

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